A LaTeXSample

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Chapter 1

Intro

1.1 Introduction

How do we get these symbols \$, # , _, %,{,}

Exercise 3.1 How did I bold the Example name?

(a) Why did the enumeration start with (a) and not 1.?

(b) When we reference mathematical variables we need to encapsulate them in in-line math mode, i.e. $u(T)$ and $d(T)$ for $T = 3, 4, 5, 6$.

(c) Let's start off easy and write some greek letters. $\alpha, \beta, \gamma, \Gamma, \xi, \zeta, \omega, \kappa, \Omega, \Delta, \delta, \varepsilon, \epsilon$. Notice we have capitals by capitalizing the first letter of the command. We also have different styles of the same letters. Notice the difference between "epsilon" and "varepsilon".

(d) Often one needs to define the reals, naturals, etc. We do this by using the mathbb command. $\mathbb{R}, \mathbb{N}$, etc.

(e) What if we want to refer to the set of Riemann integrable functions? We use mathcal. $\mathcal{R}(\mathbb{R})$.

(f) Suppose we want to use set notation we need to use the command for curly braces.

$$\mathcal{F} = \{\emptyset, \Omega, \{H\}, \{T\}\} \tag{1.1}$$

(g) Fractions use the "frac" command with two entries.

```
\frac{1}{2}
```

gives us $\frac{1}{2}$. There are other variants of this command such as sfac dfrac and xfrac. cfrac is used when we wish to express a continued fraction, i.e. the representation of π.

(h) Other popular commands: leq $\leq$, geq $\geq$, neq, $\neq$, approx $\approx$, subset $\subset$, supset $\supset$, subseteq $\subseteq$, subsetneq $\subsetneq$, cap $\cap$, cup $\cup$, partial ∂

(i) The sqrt function gives us $\sqrt{n}$, but we can add [k] to the command to get $\sqrt[k]{n}$.

(j) How do we write the following expressions?

$$\int_a^b x\,dx = \frac{1}{2}x^2\Big|_a^b = \frac{1}{2}\left(b^2 - a^2\right) \tag{1.2}$$

$$\int_{\{A\in\mathcal{F}\}} X(A)\,d\mathbb{P} \tag{1.3}$$

(k) Accents are done through many commands, i.e. tilde{ x} $\tilde{x}$, overline $\overline{x}$. These may be different commands in mathmode than in text mode so be careful with your usage

(l) If we have parenthesis around an expression they can be the wrong size, i.e.

$$2 \cdot (\frac{\frac{a}{b}}{(\frac{c}{d}+12)}) \tag{1.4}$$

But we can deal with this using

```
2 \cdot \left( \frac{\frac{a}{b}}{\left(\frac{c}{d}+12\right)} \right)
```

$$2 \cdot \left(\frac{\frac{a}{b}}{\left(\frac{c}{d}+12\right)} \right) \tag{1.5}$$

(m) Sometimes math font may be smaller than we want, we can use several commands to deal with this. An example:

$$y(t) = \frac{1}{\beta} e^{-\frac{1}{\alpha}\sum_{i=1}^{n} X(t)} \tag{1.6}$$

becomes

$$y(t) = \frac{1}{\beta} e^{-\frac{1}{\alpha}\sum_{i=1}^{n} X(t)} \tag{1.7}$$

This is done through the "displaystyle" command. There are othe similar commands like mathlarger mathsmaller.

(n) If we write a limit in in-line mode we get $\lim_{n\rightarrow\infty} x_n$, but we want this to appear as $\displaystyle\lim_{n\rightarrow\infty} x_n$. The displaystyle command does this as well. Note: we use "rightarrow" and "infty" commands here.

(o) An example using the cases argument.

$$P(t+1,T) = \begin{cases} u(T)\frac{P(t,T)}{P(t,t+1)} & \text{if } \omega = H \\ d(T)\frac{P(t,T)}{P(t,t+1)} & \text{if } \omega = T \end{cases} \tag{1.8}$$

- Not only can we enumerate but we can make bullets
- I'm another bullet
- We can do math mode here too: $a^2 + b^2 = c^2$.

Chapter 2

Small Chapter

start=5 Why is this starting at the number 5?

(1) Notice we can nest enumerations

Chapter 3

Matrices and Arrays

3.1 matrices

$$\begin{bmatrix} 0 & 2 & 12 \\ 1 & 3 & 17 \\ 41 & 12 & \alpha \end{bmatrix} \tag{3.1}$$

1. We can write this same matrix without the [and]. Why isn't the next equation numbered, but equation (3.1) is?

2. How did we reference the equation (3.1)?

3. different types of matrices

$$\begin{matrix} 0 & 2 & 12 \\ 1 & 3 & 17 \\ 41 & 12 & \alpha \end{matrix}$$

$$\begin{pmatrix} 0 & 2 & 12 \\ 1 & 3 & 17 \\ 41 & 12 & \alpha \end{pmatrix}$$

$$\left\| \begin{matrix} 0 & 2 & 12 \\ 1 & 3 & 17 \\ 41 & 12 & \alpha \end{matrix} \right\|$$

$$\begin{Bmatrix} 0 & 2 & \cdots & 12 \\ 1 & 3 & \cdots & 17 \\ \vdots & \vdots & \ddots & \vdots \\ 41 & 12 & \cdots & \alpha \end{Bmatrix}$$

4. the last matrix uses vdots, cdots, and ddots.

3.2 Arrays

1. Sometimes we want a series of implications. We use the Rightarrow command in an array.

$$\begin{array}{rrcl} & f_1(E[X]) + f_2(E[X]) & \leq & E[f_1(X)] + E[f_2(X)] \\ \Rightarrow & f_1(E[X]) + f_2(E[X]) & \leq & E[f_1(X) + f_2(X)] \\ \Rightarrow & f(E[X]) = (f_1 + f_2)(E[X]) & \leq & E[f_1(X) + f_2(X)] = E[f(X)] \end{array}$$

2. Create this table (A table is really just an array) the — places a vertical line and c says to align it centered

T	1	2	3	4	5	6
P(0,T)	0.96	0.92	0.87	0.82	0.77	0.73

Chapter 4

More

4.1 MATLAB code

m2tex.m is a nice MATLAB m-file which allows you to convert m-code to a .tex format to be included into your file. I use the "include" command to acces the .tex file this created and we get

```
function [] = GeometricBM( n,T,S0,sigma,alpha )
%GeometricBM Plots a geometric Browninan Motion approximation
%   Takes the following Inputs:
%   n: the number of discrete nodes per unit of time
%   T: Stopping Time (starts at 0)
%   S0: Risky Asset Initial value
%   sigma: risky asset volatility
%   alpha: drift rate of the risky asset
%
%   Output: Plot
%
%   Plots the function e^{(\alpha-\frac{1}{2}\sigma^2)t+\sigma W_t^n}
%   where W_t^n is a symmetric random walk


walkStepSize=1/sqrt(n);
%% Geometric Brownian Motion

SLast=S0;
sum=0;
for i=1:1:n*T
    upOrDown=randi([0,1],1,1); % returns random entry of 0 or 1
    if upOrDown==0 %change zeros to minus ones
        upOrDown=-1;
    end
    sum=sum+upOrDown*walkStepSize;
    Snew=S0*exp((alpha-1/2*sigma^2)*(i/n)+sigma*sum);
    x=[(i-1)/n,i/n];
    y=[SLast,Snew];
    plot(x,y);
    hold on;
    SLast=Snew;
end

xlabel(gca,'Time');
ylabel(gca,'Price');

end
```

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Often times it can be useful to create the chapters in individual tex files and then just include them in another tex file which handles all the formatting.

4.2 Include images

1. A sample image

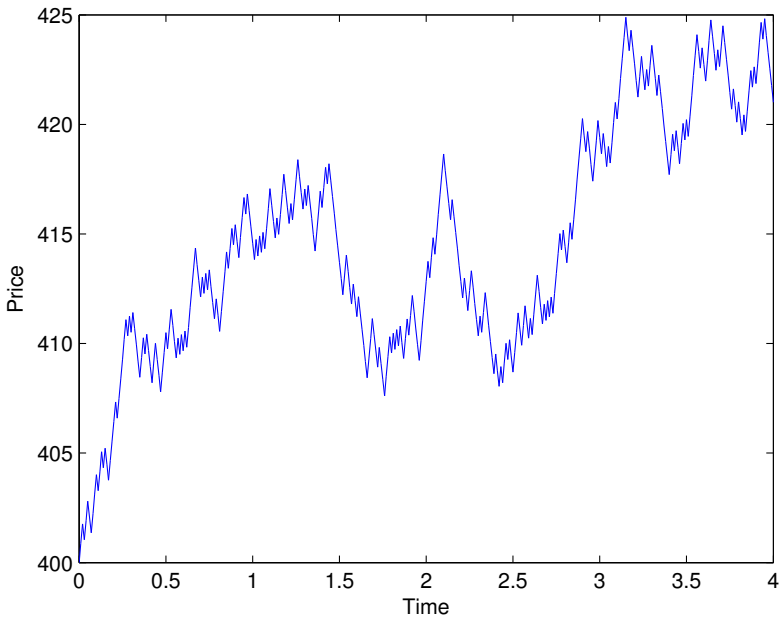

Figure 4.1: A Geometric Brownian Motion with $n = 100$ and $T = 4$, $S_0 = 400$, $\alpha = 0.02$, $\sigma = 0.02$.

We can reference this figure as (Figure 4.1)

Chapter 5

New Commands

When one is writing a paper in which a complex sequence of commands occurs often, it is easier to define a new function rather than writing the same commands time and time again. For instance if you need to use the same vector $\mathbf{u}$ many times we can define the function in our preample using

```
\DeclareMathOperator{\uvec}{\mathbf{u}}
```

this can be found in the preamble of this document. While this command may not be very difficult to type, some are. Imagine we were using conditional expectations w.r.t sigma algebras often, we would have to type the command

```
\mathbb{E}^\mathbb{Q} \left[ \left. \frac{X}{Y}   \right| \mathcal{F}_t \right]
```

which gives us

$$\mathbb{E}^{\mathbb{Q}} \left[\frac{X}{Y} \middle| \mathcal{F}_t \right] \tag{5.1}$$

This is a very tedious task.

Instead we can define a new command in our preamble

```
\newcommand{\condX}[2]{\mathbb{E}^\mathbb{Q}

 \left[\left. #1   \right| \mathcal{F}_ {#2} \right]}
```

The [2] means that this command expects two variables and these are inserted at the respective hash tags. Because the command we defined uses math-mode commands it can only be used in the math environment.

Now we can use this command by typing,

```
\begin{equation}
\condX{\frac{X}{Y}}{t}
\end{equation}
```

$$\mathbb{E}^{\mathbb{Q}}\left[\frac{X}{Y}\middle|\mathcal{F}_t\right] \tag{5.2}$$

Chapter 6

Bibliographies: BibTex

Even though this line isn't actually cited from this paper we referenced it as if it were [**?**].

In the attached PaperBib.bib file you can notice several types of referenced sources. Articles and books will probably appear the most. Most are straightforward and the typical syntax is

```
@book{Vernescu,
author={Vernescu, Bogdan and Mei, Chiang C.},
title={Homogenization Methods for Multiscale Mechanics},
publisher={World Scientific},
year={2010}
}
```

Here the @ symbol allows us to tell bibtex that there is a new entry and is followed by the entry type...{ Vernescu, opens the fields and says that our reference name is Vernescu. When we wish to reference this book we use [**?**]

```
\cite{Vernescu}
```

For different types of bib entries there are different fields and these can be found at

```
http://en.wikipedia.org/wiki/BibTeX
```

or

```
 http://en.wikibooks.org/wiki/LaTeX/More_Bibliographies}
```

The most difficult is url and requires the use of the package

```
\usepackage{url}
```

. Please refer to the last entry in the bibtex file for the formatting on this.
The following Lines allow us to access our .bib file

```
\bibliographystyle{plain}
\bibliography{PaperBib}
```